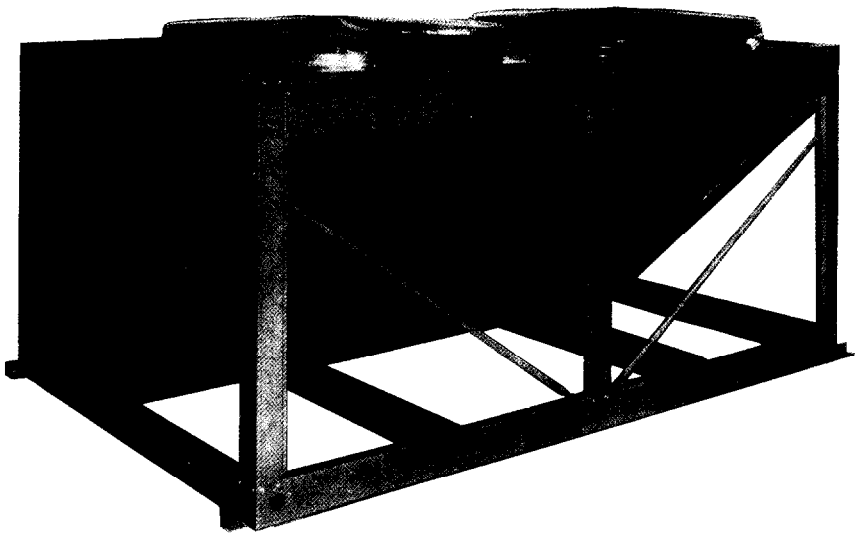
installation, operation and maintenance INSTRUCTIONS

for Models PD 040A2, PD 040B2,
PD 050A2, PD 050B2



INSTALLATION

RECEIVING AND HANDLING

The unit should be inspected immediately after receipt for possible shipping damage. The PD water chillers are shipped f.o.b. factory, and all claims for handling and shipping damage are the responsibility of the consignee.

NOTE
All PD units are shipped with complete refrigerant operating charge. Leave the shipping skid in place until the unit is in its final position. This will aid in handling the equipment.

The unit can be lifted after fastening the rigging lines to the 4 lifting plates located at the base of the unit. These are illustrated in Fig. 1. Spreader bars should be used between the rigging lines to prevent damage to the unit. If spreader bars are not available, long cables may be used with two-by-four's inserted between the cables and the top of unit.

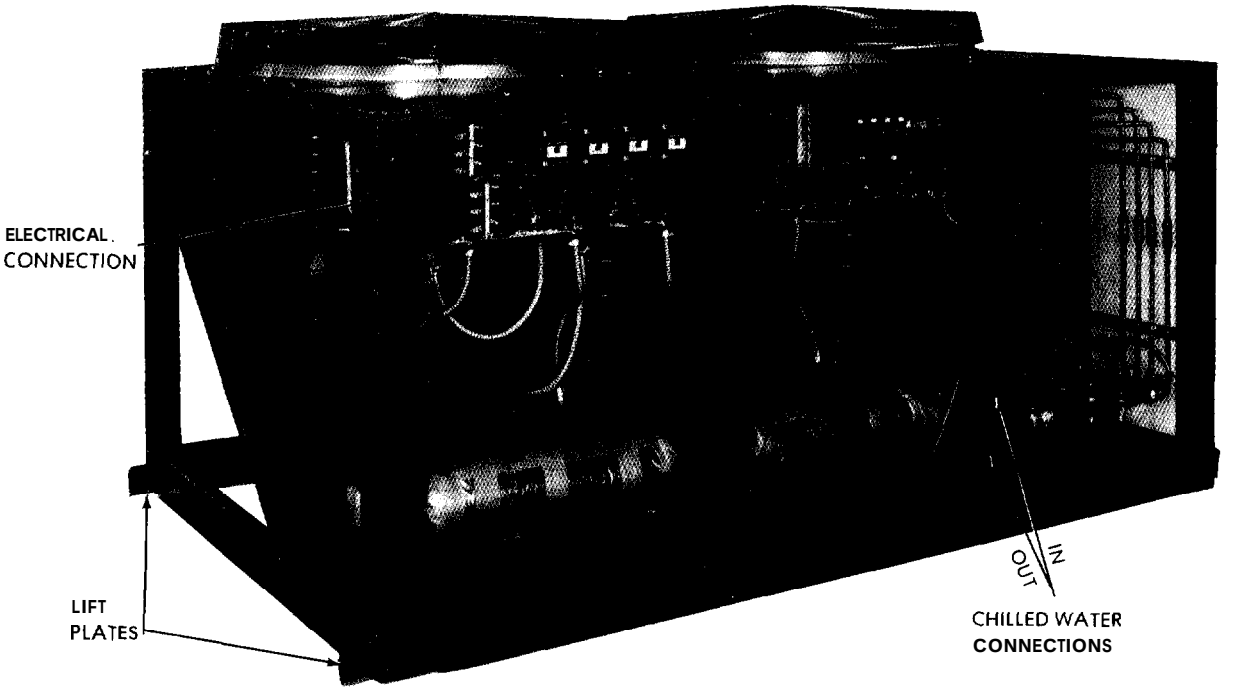
LOCATION AND MOUNTING

The PD chiller should be located so as to provide the following minimum service clearances: 4 ft. in front of unit, 5 ft. on left-hand side of unit when facing control panel, 10 ft. on right-hand side and 5 ft. on condenser side of unit. It would be preferable to face the condenser away from prevailing winds. The vertical discharge air should be unobstructed.

Make certain that the mounting surface is adequate to support the full weight of the unit, (refer to Table 1 for unit weight) and if there is any possibility of unit vibration annoying building occupants, vibration isolation pads should be installed.

PRESSURE TESTING (if repair necessary)

No pressure testing is necessary, unless some damage was incurred during the shipment of the unit and it is necessary to make repair to the re-



frigerant circuit. In this case, the repairs should be made, and the unit pressure tested at a pressure not to exceed 100 PSIG and evacuated prior to charging. These latter two procedures are described in the paragraphs that follow.

LEAK TESTING (if repair necessary)

In the case of loss of the refrigerant charge, the unit should be checked for leaks prior to charging the complete system. This can be done by charging only enough refrigerant into the system to build the pressure up to approximately 30 PSIG and adding sufficient dry Nitrogen to bring the pressure up to a maximum of 100 PSIG, then leak test with a Halide or electronic leak detector.

CAUTION
DO NOT USE OXYGEN TO BUILD UP PRESSURE AS A SERIOUS EXPLOSION CAN RESULT.

A pressure regulating valve should always be used on the drum that is being used to build up the system pressure. When the test pressure is reached, disconnect the gas cylinder.

If any leaks are found in welded or silver-soldered joints or if it is necessary to replace a gasket, relieve the test pressure in the system before proceeding. For copper joints, Easy-Flo silver solder is recommended.

After making any necessary repair, the system should be evacuated, as described in the following paragraph.

EVACUATION (if repair necessary)

After it has been determined that there are no refrigerant leaks, the system should be evacuated, using a vacuum pump with a capacity of approximately 3 cu. ft./min., which will reduce the vacuum to at least **1** millimeter (1000 microns).

A Mercury manometer, electronic or other. type of micron gauge, should be connected at the furthest point from the vacuum pump. For readings below 1 millimeter, the electronic or other micron gauge should be used.

The triple evacuation method is recommended and is particularly helpful if the vacuum pump is unable to obtain the desired 1 millimeter of vacuum. The system is first evacuated to approximately 29 in. of vacuum. Enough refrigerant is then added to the system to bring the pressure up to zero pounds. Then the system is once again evacuated to approximately 29 in. of vacuum. This is repeated 3 times. The first pull down will remove about 90% of the noncondensables, the second about 90% of that remaining from the first pull down. and after the third, approximately 1/10 of 1% noncondensables will remain.

CHARGING THE SYSTEM (if repair necessary)

All type PD water chillers are leak tested at the factory and shipped with the correct charge of refrigerant-22, as indicated in Table I. In the event the refrigerant charge was lost due to shipping damage, the system(s), after first repairing any leaks and evacuating should be charged as follows.

If a complete refrigerant charge must be added to a system, the preferred method would be to weigh the charge. This provides the most accurate method, otherwise the unit must be operable and high summer head pressure must be simulated.

Liquid refrigerant must never be added to a system that has a system gas pressure below freezing (58 PSIG). The system gas pressure should be built up by vapor charging until this pressure is reached and then reverting to liquid charging as necessary.

Whenever liquid refrigerant is being added to a system, (except liquid line), the compressor

should be running and the refrigerant allowed to enter the system very slowly or compressor damage will occur.

PREFERRED METHOD (Weighing Charge)

1. Check, and open if necessary, the compressor discharge service valve and the liquid line service valve.
2. Evacuate system as outlined in evacuation section.
3. Start chilled water pump to protect chiller from freeze damage.
4. Connect refrigerant drum to the liquid line service valve of system to be charged.
5. Break system vacuum with refrigerant vapor and allow system pressure to build up to at least 58 PSIG. This will prevent freeze damage to chiller.
6. When the required amount of vapor pressure has been obtained in system, the remaining amount of refrigerant can be bled into system in the liquid state. If refrigerant drum pressure should equalize with system pressure before the full charge has been transferred to system, the charging point will have to be shifted to the Schrader fitting on suction line and the compressor started.
7. When twenty-two pounds of refrigerant 22 has been added to system, that circuit is fully charged.

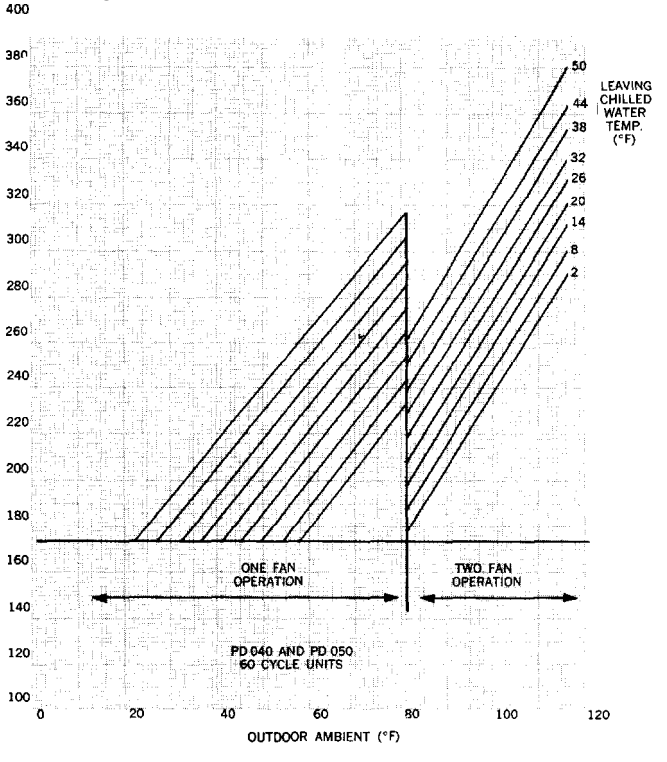


Fig. 2.

ALTERNATE METHOD

If the preferred method of charging the system is impossible, the alternate method can be used.

1. Open if necessary the compressor discharge and liquid line service valves.
2. Start chilled water pump.
3. Evacuate system if possible, but if only a small amount of refrigerant was lost this will not be necessary.
4. Connect refrigerant drum to Schrader fitting on compressor suction line.
5. Start compressor and add refrigerant to system.
6. The system can be considered fully charged when the pressures in Figure 2 are obtained.
7. An alternate method of determining the state of charge is to get the discharge pressure up to 300-350 pounds and adjust the refrigerant charge to obtain ten degrees of sub-cooling.

ELECTRICAL CONNECTIONS

Refer to Electrical Data Sheet PD-D2A (or) PD-D3A and the wiring diagrams located inside of the front cover of unit control center. The field connections are shown in the shaded area.

Conduit connections are provided on the left-hand side of the control center, to bring in power as well as to control wiring.

Wire, disconnect and Fusetron sizes are shown in Electrical Data PD-D2A (or) PD-D3A and Field Connection Diagram. Fusetrons are recommended, since they can be sized much closer to the actual motor running current than standard fuses. Even though sized very close to the running current, Fusetrons will not blow out during the higher inrush current at start, due to a built-in time lag. This, therefore, gives much better motor protection.

The unit must be interlocked with the chilled water pump, such as a flow switch or auxiliary contacts on chilled water pump motor starter. The field connections are shown in the shaded area of wiring diagram, connecting to terminals numbers 1 and 2 of terminal block. The interlocking means must be provided by the installing contractor.

If an indoor ON/OFF switch is desired, it may be connected to the same terminal block as the chilled water pump interlock. Connect switch to terminals 2 and C. If indoor switch is not used, connect jumper between terminals 2 and C.

This equipment has a 220 V control circuit. For higher voltage units (above 240V rating), a control transformer is supplied, mounted and wired to provide the 220 V control voltage. The control transformer on the PD 050 has an excess capacity of 50 VA. The PD 040 has an excess capacity of 150 VA.

CONTROL CENTER

The control center contains all the necessary protective and operating controls. These include the 3 or 4-step operating thermostat, compressor motor winding thermostat, low water temperature cutout, low refrigerant temperature cutouts and high and low pressure cutouts. In addition, the control center includes the compressor and fan motor starters, together with the quick trip overload protection. A time delay relay is also included, to prevent a simultaneous start of all compressors. An ambient thermostat (LT) controls the on/off cycle of the

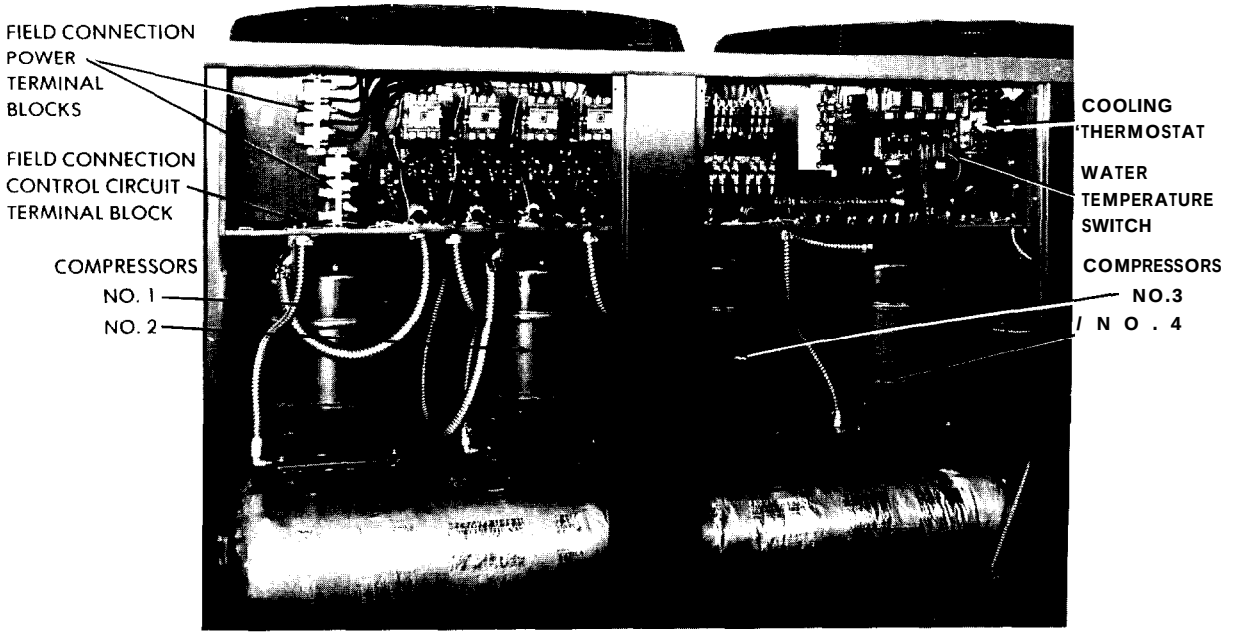


Fig. 3.

chiller heater, which, during low ambient conditions only, provides freeze protection for the chiller.

An interior view of the control center is shown in Figure 3.

The low refrigerant and the low water temperature thermostat is of the automatic reset type, and the compressors will cycle on these protective devices. The high and low pressure cutouts, overloads, and motor winding thermostat, are wired into a lockout circuit and must be manually reset from either one of two reset switches. The reset switches are located on the outside right end of control center, see Figure 3. The PD 050 has 4 system switches and the PD 040 has 3. They function as follows. The compressor protection circuit is wired so that the lockout feature will lock out 2 compressors, even though only 1 compressor requires locking out. The other compressor can be restarted by operating the corresponding system switch, which shunts out the effected compressor safety components, and by opening the circuit to the effected compressor starter operating coil. By resetting the lockout circuit, the other compressor can be restarted.

QUICK-TRIP MOTOR OVERLOAD PROTECTION

Quick-trip hermetic compressor motor overload protection is provided as standard equipment on all PD water chillers, providing greatly increased motor protection against stalled (locked rotor) conditions.

CRANKCASE HEATER

Each compressor has a 100-watt crankcase heater that operates only when the compressor is in the off cycle. It prevents refrigerant from migrating into the compressor when the compressor is not running.

COMPRESSOR TIME DELAY RELAYS

PD 050-A built-in time delay relay (1.0 second) separates thr: starting of compressors #1 and #2 from #3 and #4.

An accessory relay may be added to the control panel to separate compressor #2 from compressor #1. The coil should connect to terminals B and Y, and the contacts should connect to terminals D and E. An accessory relay may be added to control panel to separate compressor #4 from compressor #3. The coil should connect to terminals F and M, and the contacts should connect to terminals M and N.

PD 040-The built-in time delay relay (1.0 second) separates the starting of compressor #2 from compressor #1 and #3.

An accessory relay may be added to the control panel to separate compressor #3 from compressor #2. The coil should be connected to terminals E and M, and the contacts should connect to terminals M and N.

CHILLER FREEZE PROTECTION HEATER

The PD chiller has a 275-watt resistance heating element under the chiller insulation, mounted directly against the shell of the chiller. It is controlled by a thermostat (LT) whose sensing bulb is mounted on the chiller shell. The purpose is to protect chiller from freeze up during low ambient weather. This element will protect the chiller down to - 10°F outdoor ambient if all panels are in place and the electrical power is not interrupted.

NOTE

The installing contractor should provide adequate freeze protection to the external water piping.

IF IT IS EXPECTED THAT THE OUTDOOR TEMPERATURE WILL DROP BELOW —10°F, THE CHILLER MUST BE DRAINED OF ALL WATER.

The chiller heater becomes energized at 36°F shell temperature.

THE UNIT CONTROL CIRCUIT MUST BE ENERGIZED AT ALL TIMES IN ORDER TO PROVIDE POWER FOR THE CHILLER HEATER.

CONDENSER FANS

Each unit has 2 belt-driven propeller fans for condenser cooling. Each fan is driven by a permanently-lubricated type, 3-phase motor. However, for long bearing life assurance, it is recommended that the fan shaft bearings and motor bearings be lubricated once a year, with Westinghouse ball bearing grease Part No. **1781386.** The fans must turn in a clockwise direction, as viewed from above the unit.

WATER CONNECTIONS

CHILLED WATER PIPING-Figure 1 shows the piping arrangement for a standard unit. The water must enter the top connection and leave from the lower. If two or more units are connected to a common water system the units would be connected for parallel water flow.

Special units may be ordered from the factory for series water flow applications. These units are marked at the factory, "upstream unit" and "downstream unit," and **must be** piped in this manner because of control reasons. The water must enter the chiller at the two connections shown in Figure 1 and leave by the connection (not shown) located at opposite end of chiller.

The chilled water piping should include sufficient shut-off valves to permit draining the water from the chiller without draining the complete system.

Also, it should include thermometers at the inlet and outlet connections, and air vents at the high points. The piping should be located and supported so that excessive weight is not borne by the chiller connections. The piping should also be adequately insulated.

In cases where the chilled-water pump noise may be objectionable,. it is recommended that rubber sections be used in both the inlet and outlet of the pump.

Small water pressure test valves are provided at both the inlet and outlet connections to the chiller. This permits checking of the water pressure drop through the chiller. The pressure drop through the chiller is shown in Table III, and the maximum flow should not exceed 185 GPM.

A cleanable-type water strainer with a mesh of approximately 20 is recommended at the inlet to the chiller. It is absolutely essential on installations where the chilled water piping is made up of steel pipe with welded joints or where the water or piping is subject to considerable foreign matter.

NOTE

The temperature of water flowing through the water chiller should never exceed 120°F. This limitation should be noted when common water piping is used in connection with a heating system.

PRELIMINARY CHECKS BEFORE STARTING

Before attempting to place the equipment into operation, the following steps should be taken.

1. Check to make sure that all refrigerant shut-off valves are open. (Compressor discharge service valve, and liquid line valve from condenser in each circuit.)
2. Open all water valves to the chiller, and see that water flow is possible when the water pump is energized.
3. Check that the actual line voltage is within the required plus or minus 10% of unit nameplate voltage rating.
4. **Make sure** that all shipping protection has been **removed.**
5. With the main disconnect switch in the "off" position, make sure all line-starter contacts meet with even pressure and that all moving parts move freely. Check that the Fusetrons are in the circuit and that the thermostat is set below the chilled water temperature.
6. Apply the 2 caution decals (cautioning against disconnecting power to chiller heater), found in unit literature envelope, to front cover of unit disconnect switches.
7. The compressors must not be started until the crankcase heaters have been energized for at least twelve hours.

STARTING AND OPERATIONAL CHECKS

Immediately after starting the unit, the checks below should be performed:

1. Check condenser fan for proper rotation, clockwise as viewed from above the unit.
2. Check the compressor(s) motor amperage to make sure it is normal. The correct amperage is given on the compressor nameplate and is included also in the Electrical Data PD-D2A and PD-D3A.
3. Check the operation of all the protective controls to make certain that each interrupts the control circuit and stops the compressor. The correct settings for the controls are given in Table II.
4. One of the most frequent complaints during the early history of a water chilling system is that of low suction pressure and the unit cutting out on the low refrigerant temperature control. Several causes for this condition are listed below:
   - **a.** Air in water circuit of water chiller.
   - **b.** Inadequate quantity of water (check pressure drop through chiller; see Table III for flow).
   - **c.** Water pump not functioning properly.
   - **d.** Plugged water strainer.
   - **e.** Operation at lower than design water temperature.
   - f. Inadequate air over air-handling coils.
   - g. Lack of low side load. Operating with only a portion of air units installed.

5. Record a complete set of operating data for future usage; preserve these in your own or the customer's file. This data should include complete nameplate infomation on the PD unit.

6. Instruct the owner on proper operation and care of the system.

SYSTEM LIMITATIONS

1. Voltage must be within 10% of unit rated voltage.
2. Maximum outdoor ambient with 50°F leaving water is 110°F.
3. Minimum leaving water temperature is 40°F, for a standard unit.
4. Minimum operating outdoor ambient temperature for a standard unit is 35°F.
5. Minimum operating outdoor ambient temperature for a low ambient unit is 0°F.
6. Water flow through chiller should not exceed **185** GPM.
7. For units using glycol solution in chiller, the minimum leaving solution temperature would be 15°F. The minimum outdoor temperature is zero degrees F.

OPERATION

OPERATION

1. Relays 1LR and 2 LR are the lockout relays. They are usually energized, but must be de-energized with switch RM, in order to reset a PR relay that has had its circuit interrupted by a safety device.
2. The 1PR and 2PR are the protection relays and must be energized for the compressor to run. The safety controls in series with the PR relay are of the automatic reset type, but a momentary interruption of current will de-energize a PR relay. The PR relay that has been de-energized by a safety control can be reset by operating switch RM, which will de-energize LR and allow PR to reset, providing the safety control has reset.
3. The system switches (SS) are necessary because 2 compressor safety circuits are connected to a single PR relay. For an example, let's assume that #1 refrigeration circuit is short of refrigerant. Number 1 compressor suction pressure will drop until the low pressure cut-out contacts open at about 7 PSIG. This will de-energize the starter holding coils 1M and de-energize lPR, which in turn will de-energize the starter holding coils. 1M and 2M, and stop compressors 1 and 2. The system switch (1SS) can now be operated, which will shunt or bypass the low pressure cutout, and open the circuit to 1M starter holding coil. The LR relay can now be de-energized with lRM, allowing 1PR to re-energize, and #2 compressor will now operate.
4. The TD relay prevents a simultaneous start of all compressors. During normal operation, #1 compressor is the first to start and the last to stop, with the number of compressors runnmg being determined by operating thermostat TC. With a power interruption, the chiller water could warm up; and when power is restored, the operating thermostat could be calling for maximum cooling. If this were to happen with the PD 040, #1 and #3 compressors would start simultaneously; and after a time delay of 1 second, #2 compressor would start. The PD-050 would have # 1 and #2 compressors starting together; and after a 1 second time delay, #3 and #4 would start.

THERMOSTAT SETTING

Each unit is equipped with single multi-step operating thermostat, with the control bulb located in the return water circuit. On the PD 040, there are 3 steps (3.5°F between steps). On the PD 050, there are 4 steps (2.5°F between each step). THE SETTING BETWEEN INDIVIDUAL STEPS IS FACTORY SET AND SEALED AND MUST NOT BE CHANGED IN FIELD. TO DO SO WILL VOID THE WARRANTY.

LOW AMBIENT

A condenser fan thermostat is used on all units for low ambient operation. The thermostat drops out one condenser fan when the outdoor air temperature drops to 80°F. In addition, an accessory pressure operated damper assembly is factory installed over the No. 1 condenser fan on units so ordered. The damper operator is normally controlled by the head pressure of No. 1 compressor. However, if the No. 1 compressor should become inoperable, the pressure connection should be shifted to the No. 2 compressor.

MAINTENANCE

LUBRICATION

Even though the condenser fans are permanently lubricated, longer bearing life will result if the motor and fan shaft bearings are lubricated once a year.

The compressor crankcase oil shouldn't require any attention, unless, due to a large refrigerant leak, a large amount of oil is lost from the system.

INSPECTION

The condenser fan belts should be inspected after the first week of operation and if loose, tightened. The fan belts should also be inspected at least once a year for tightness and fraying. If the belts show signs of fraying, they should be replaced. The condenser fan belts are matched sets and should be replaced together. Whenever the fan belts are replaced, they should be tightened after a week of

operation.

PUMPING DOWN

If it becomes necessary to pump the system down, extreme care should be used to avoid damage to the water chiller due to freezing. Always make sure that full water flow is maintained through the chiller while pumping down. It is suggested that the pump down be accomplished in 3 steps, as follows:

1. With the condenser liquid line valve closed, and with water flowing through the water chiller, start the compressor and allow it to operate until the suction pressure reaches 30 PSIG, at which time the compressor should be stopped.
2. After waiting approximately 5 minutes, start the compressor again. Operate the compressor until the suction pressure reaches approximately 5 PSIG or until the low pressure cutout stops the compressor.
3. After waiting approximately 5 minutes, again operate the compressor until the suction gauge reads approximately 5 PSIG, stop the compressor, close off the discharge shutoff valve, and open the compressor disconnect switch.

SEASONAL SERVICING

Prior to seasonal shutdown periods, and before starting again, the following service procedures should be completed.

SHUTDOWN

1. Where freezing temperatures may be encountered, chiller water piping should be disconnected from the supply and drained of all water, or adequately protected by electric heating cable covered by insulation. Water permitted to remain in the piping will rupture these parts if subjected to freezing temperatures. Heaters installed around chiller are sufficient to maintain above freezing temperatures in that location at minus 10" outdoor temperatures. If chiller is not drained, lock or tag disconnect switch closed, to prevent power interruption to chiller heater.
2. Take measures to prevent the shut-off valve in the water supply line from being accidentally turned on.
3. If the chilled water pump is exposed to freezing temperatures, be sure to remove the pump-drain plug and leave it removed so that any water which may accumulate will drain away.
4. Open compressor disconnect switch and remove Fusetrons only if chillers are drained.
5. Check for corrosion, clean and paint rusted surfaces.

STARTUP

1. The crankcase heater circuit should be energized approximately 12 hours before starting the compressor.
2. Check and tighten all electrical connections.
3. Replace drain plug in the chilled water pump if it was removed at shutdown time the previous season.
4. Install Fusetrons in main disconnect switch.
5. Reconnect water lines and turn on supply water and check for leaks.
6. Clean all surfaces and remove all litter.
7. Refer to procedures of "Preliminary Checks Before Starting" before energizing the compressor circuit.
8. Refer to procedures of "Starting and Operational Checks" after starting the compressor.

TABLE I. PHYSICAL DATA

	UNIT MODEL	
	PD 040	PD 050
Weight of Unit	4175 Lbs.	5100 lbs.
Refrigerant Charge per Circuit	22 Lbr. R-22	22 Lbs. R-22
Chiller Connection Size	3" M P T	3" M P T
Pressure Relief Setting	300 PSIG	300 PSIG
Compressors	(3) CH 150A	(4) CH 150A
Chiller Model	TB 029W	TB 039W
Chiller Freeze Protection Heater	275W	275W

TABLE II. SAFETY CONTROL SETTINGS

	UNIT MODEL	
	PD 040	PD 050
High Pressure Cut-out	385 PSIG	385 PSIG
Low Pressure Cut-out	7 PSIG	7 PSIG
Low Refrigerant Temperature Cut-out	28°F	28°F
Low Water Temperature Cut-out	34°F	34°F
Chiller Heater Cut-in (diff. 3.5°F)	36°F	36°F

TABLE III. WATER PRESSURE DROP-FEET OF WATER

	WATER FLOW IN GPM												
Unit Model	60	70	80	90	100	110	120	130	140	150	160	170	185
PD 040	6.5	8.8	11.5	14.5	18	21.5	25	30	35	39	45	50	60
PD 050	3.7	5.0	6.5	8.1	10	12	14.5	17	19.5	22.5	25	29	32

NOTE: 1. Water flow should not **exceed 185 GPM.**

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